Method and arrangement in a telecommunication system

**FIELD OF THE INVENTION**

The present invention relates to methods and arrangements in
5    a mobile 3$^{rd}$ generation communication system and user
equipments intended for usage in such systems. The invention
relates in particular to charging of user equipments
participating in a Multimedia Broadcast/ Multicast Service
(MBMS). According to the state of the art, a communication
10   system applying MBMS transmits MBMS-data from a single
source entity to multiple recipients in the downlink. The
service is considered to be a "best-effort" service, e.g.
with no requirements for retransmissions in case on lost
data.

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**SUMMARY OF THE INVENTION**

The present invention addresses the problem of collecting
relevant charging information from user equipments using
broadcast/multicast services and, thus, provide network
20   operators with necessary information to enable billing of
said user equipments.

The solution according to the present invention proposes to
introduce an uplink channel for transmitting MBMS-related
control information, e.g. to indicate participation requests
25   for specific MBMS-services or acknowledgement information
regarding the reception status of MBMS-data messages that
have been sent to user equipments. The present invention
further intends to introduce a decoding key for coding and
decoding the content of said transmitted MBMS-data messages.

According to the inventive method user equipments must apply
to participate in an MBMS-session of a certain MBMS-service
and, depending on the type of said service, acknowledge the
reception of MBMS-data messages during the ongoing session.
5   The user equipment is charged by the network in response to
transmitted   acknowledgement   messages   for   successfully
received MBMS-data messages and receives decoding keys from
the   network   in   response   to   a   charging   for   previously
received MBMS-data messages. The decoding key can be valid
10  either   during   the   entire   MBMS-session,   parts   of   such   a
session, or for only one received MBMS-data message. This
validity   time   is   in   principle   definable   by   the   network
operator.   Further,   when   transmitting   several   decoding   keys
during   an   MBMS-session   the   present   invention   allows   the
15  operator to apply an adaptive charging for transmitted MBMS-
data messages during the lapse of an MBMS-session.

The present invention implies the advantage for the operator
to allow an efficient billing of user equipments using an
MBMS-service   that   can   be   based   on   various   charging
20  criterions, e.g. based on the duration of an MBMS-session or
the   time   a   user   equipment   has   participated   in   such   a
session, or can be based on the amount of data information
that has been delivered to the user equipment.

It   is   another   advantage   of   the   present   invention   that   it
25  allows an adaptive charging of user equipments. This means
that   the   network   operator   can   apply   different   charging
profiles, e.g., with respect to the lapsed time of an MBMS-
session, or, if experienced by the user, to compensate for
value   changes   of   MBMS-data   messages   with   regard   to   their
30  content or reception quality. The introduction of an uplink
channel   opens   also   for   possibilities   to   apply   different
charging   models   for   various   sub-groups   of   subscribers   that
participate in one and the same MBMS-session.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings and claims.

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## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a signalling flow of an MBMS-session between network and a user equipment according to a first embodiment of the present invention.

10   Figure 2 shows a signalling flow of an MBMS-session between network and a user equipment according to a second embodiment of the present invention.

Figure 3 shows the signalling flow of an MBMS-session between network and a user equipment in case of a missing
15   or erroneous transmission of an MBMS-data message.

Figure 4 shows a signalling flow of an MBMS-session between network and a user equipment according to a third embodiment of the present invention.

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## DETAILED DESCRIPTION

The following detailed description will describe several embodiments of the solution according to the present invention. The embodiments can be distinguished with regard
25   to the possibilities when the user equipment is charged for MBMS-data messages and when the decoding key for decoding received MBMS-data messages is provided to the user equipment. The embodiments can be applied with regard to different types of MBMS-services that are distinguishable,
30   e.g., with regard to time aspects, i.e. real time or non-

real time services, regarding how often or regularly such a service is required, or regarding the type of service, e.g. downloading services or various types of automatic information updating services.

5    It is a first important feature of the present invention to introduce an uplink channel for transmission of signalling information related to an MBMS-session that a user equipment participates in. The MBMS-uplink channel can be realised on a common uplink channel or as dedicated channels between
10   user equipment and network. This uplink channel is used, e.g., for transmission of acknowledgement messages that acknowledge the successful reception of MBMS-data messages and, thus, provide a base for charging the user equipment. Acknowledgement messages should preferably be as short as
15   possible; they must, however, provide at least an identification indication of the user equipment that acknowledges, if no dedicated channel is used, and an identification of the acknowledged part of an MBMS-session, e.g. by help of a segment number. Within the scope of the
20   present invention an MBMS-data message is regarded to be successfully received if the message content could be presented to the user of the MBMS-service. It is in principal up to the network operator to determine how frequently and at which stages acknowledgement messages are
25   required from user equipments. This decision depends, for instance, on characteristics of the specific MBMS-service, e.g., regarding real-time aspects or regarding the rate of MBMS-data messages that is sent to a user equipment.

The uplink channel is also used by the user equipment to
30   indicate participation in a session of a selected MBMS-service. The same as required for acknowledgement messages also applies to participation messages: They must be short but at least identify the user equipment that intends to

participate in an MBMS-session and specify the session and
MBMS-service that the user equipment intends to participate
in.


A second important feature to secure an efficient charging
5   of user equipments that participate in an MBMS-session is
the coding of the content of MBMS-data messages. User
equipments will only be able to decode the content of an
MBMS-data message by help of a decoding key, which is, in
principal, sent in response to an acknowledgement message
10   that indicates that the user equipment has actually received
the data messages or, for certain embodiments, already in
response to a participation request from a user equipment.
In case of successful transmissions of MBMS-data messages
the transmission of decoding keys is triggered by a charging
15   of the user equipment for one or more previously received
MBMS-data messages.  The coding mechanism can be performed
according to well-known procedures, e.g. as described in
other 3GPP-standardisation documents. The decoding key
according to the present invention is thus used to limit the
20   distribution of the content of transmitted MBMS-data
messages, in general, to authorised user equipments, i.e.
user equipments that can be charged. The decoding key can
also be applied to define the access of user equipments to
an MBMS-session, e.g. in terms of time or in terms of a
25   number of received MBMS-data messages. The decoding key can
thus be valid for an entire MBMS-session or a part of such a
session, or for one or several MBMS-data messages.


A first embodiment of the present invention as shown in
figure 1 concerns broadcast/multicast services for real time
30   transmission of data, i.e. services that require a fast
delivery of data with low time delays. For such types of
services there is no or only little time for the network
system to wait for an acknowledgement from a user equipment

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during an ongoing MBMS-session. An example to apply such an embodiment are MBMS-sessions that relate to distinct and time-limited events, e.g., a sports event. Preferably, the user equipment is already charged 102 a fixed amount by the
5    network when indicating 101 the participation in such an MBMS-session. In response to the participation message 101, which the user equipment sends on the MBMS-uplink, the network provides a decoding key 103 to this user equipment that is valid for the entire or at least parts of the MBMS-
10   session, either measured in terms of a period of time or in terms of a fixed or maximum number of MBMS-data messages 105a,105b that will be transmitted during the MBMS-session. The decoding key is stored 104 in the user equipment and can be used to decode 106a,106b said incoming MBMS-messages
15   without additional delays that would be caused by acknowledgement messages that must be sent during the ongoing MBMS-session. This embodiment provides thus a comparatively simple charging mechanism,. which nevertheless allows an efficient and fair charging of the user
20   equipments.


Two other embodiments of the present invention, which are illustrated in figures 2 and 3, and in figure 4 relate to charging for non-real time based MBMS-services. These embodiments relate in principal to a charging of user
25   equipments during an ongoing MBMS-session in response to acknowledgement messages that the user equipment sends on the MBMS-uplink channel after a successful reception of one or more MBMS-data messages. One class of examples of such services are various kinds of reports that are automatically
30   actualised when necessary or during specific time intervals, e.g. related to current traffic status, stock exchange information, or tourist information. A characteristic of these services is that the network sends MBMS-messages more or less automatically without further intervention of the
35   user, i.e. the sending of MBMS-messages is triggered by

certain events once the user has indicated to participate in a session of such an MBMS-service. The embodiment of an MBMS-session relating to such services is in the following denoted the "streaming variant". Another class of services
5    comprises media files, e.g. voice or video information, that can be loaded into a user equipment. Such services can be characterised in that the user requests at a distinct time the transmission of one or more MBMS-messages. The embodiment of an MBMS-session relating to such services is
10   in the following denoted the "downloading variant". In both variants charging is done in response to an acknowledgement message from the user equipment indicating a successful reception of one or more MBMS-data messages. The embodiments differ, however, in the sending of the decoding key for said
15   MBMS-data messages. In the streaming variant, the decoding key that is transmitted to the user equipment is valid for one or more MBMS-data messages that will be sent to the user equipment afterwards. In the downloading variant, the decoding key is transmitted after a successful transmission
20   of one or more MBMS-data messages that have been acknowledged by the user equipment.


Figure 2 describes the message transfer between network and a user equipment for the streaming variant. The user equipment must send a participation request 201 to the
25   network in order to participate in a session of an MBMS-service. In response to said participation request the network provides the user equipment with a decoding key key#1 203, which is stored 204 in the user equipment and can be used for decoding the subsequently transmitted MBMS-data
30   messages MBMS#1 205, or several subsequent MBMS-data messages that the user equipment will receive during said MBMS-session. The network will charge 208 the user equipment for the transmitted MBMS-data message MBMS#1 after said user equipment has transmitted an acknowledgement ACK#1 207
35   indicating the successful reception of said message. In

response to such an acknowledgement message 207 the network sends a new decoding key key#2 209 for the next one or more MBMS-data messages of the session that the user equipment participates in. The streaming variant implies the advantage that the decoding of a received MBMS-data message in the user equipment can be performed comparatively fast because the decoding key is already available at that time. On the other hand, as the decoding key is available before the user equipment is charged for a delivered MBMS-data message that is related to said decoding key, either the first or last MBMS-data message cannot be charged. According to an alternative embodiment of the present invention this disadvantage can be avoided, e.g. by means of a base charge 202 at the time when a user equipment indicates to participate in the MBMS-session. This base charge can, e.g., include the costs for the first MBMS-data message.

As already described above, the transmission of MBMS-data messages according to this embodiment of the present invention can be performed more or less automatically without further intervention of the user. However, this will cause a difficulty when handling situations where a user equipment does not have received one of the transmitted MBMS-data message or, depending on the type of service, has received a faulty MBMS-data message. Such problems can occur, e.g., for a user equipment having temporarily bad radio reception conditions. As the MBMS-service is not defined to provide retransmissions it will be necessary to introduce a simple mechanism that allows to provide as many as possible of the transmitted MBMS-data messages to the user equipment and guarantees a fair charging of the user equipment regarding the relation of transmitted to actually received MBMS-data messages. An embodiment of such a mechanism is described by help of figure 3. Said figure shows a part of an MBMS-session as described in figure 2. The user equipment has received 301 and stored 302 a

decoding key key#(n-1); however, it does not receive the
MBMS-data message MBMS#(n-1) 303 that can be decoded by help
of said key. Accordingly, the user equipment will not send
any acknowledgement message for this data message, which is

5      interpreted by the network that this user equipment does no
longer intend to participate in this MBMS-session.
Therefore, the user equipment will not receive the decoding
key for decoding the following MBMS-data message MBMS#n 304.
It is now a first measure of the user equipment to re-

10     integrate in the MBMS-session that it stores 305 the MBMS-
data message MBMS#n and sends 306 an acknowledgement message
ACK#n although the user equipment cannot decode this
message. The network, which keeps track on at least the
received acknowledgement messages and possibly the segment

15     numbers of transmitted MBMS-data messages for each of the
user equipments participating in an MBMS-session, can detect
that this user equipment still intends to participate in the
MBMS-session but has not acknowledged the previous MBMS-data
message MBMS#(n-1), which implies that this user equipment

20     has not received the decoding key key#n for decoding the
latest MBMS-data message MBMS#n. The network will
nevertheless charge 307 the user equipment for the latest
MBMS-data message MBMS#n but also retransmit 308 the missing
decoding key key#n, which is the decoding key that has not

25     been sent due to the previously missing acknowledgement. The
user equipment can now decode 309, with a certain delay, the
already stored MBMS-data message MBMS#n and will send 3010
the acknowledgement message ACK#n for a second time. The
network will not charge a user equipment on reception of

30     acknowledgement messages that have already been received and
will instead transmit 3011 the next decoding key key#(n+1)
to the re-integrated user equipment.


Figure 4 describes the message transfer between network and
a user equipment for the download variant. Also in this case

35     the user equipment transmits a participation request 401 on

the MBMS-uplink channel in order to participate in a session
of a desired MBMS-service. Then, the user equipment will
receive 402a,402b and store 403a,403b one or more MBMS-data
messages MBMS#1 through MBMS#n and transmit after reception
5    of said messages an acknowledgement message ACK#1...n 304 on
the MBMS-uplink channel. It is up to the operator to define
whether each of said MBMS-data messages must be acknowledged
separately or, as indicated in figure 4, whether it is
sufficient to send one acknowledgement message that
10   acknowledges several MBMS-data messages. As already
described above, the network charges 405 the user equipment
on reception of said acknowledgement message ACK#1...n.
According to this variant the network provides the decoding
key 406 key#1...n after transmission of the MBMS-data messages
15   MBMS#1 through MBMS#n and not until after having charged the
user equipment. This variant can be in particular
advantageous for downloading larger amounts of data, e.g.
various types of media files.

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